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(पहला पुनरीक्षण)

Indian Standard

CODE OF PRACTICE FOR INSTALLATION OF OIL SUPPLY UNITS FOR FUEL — FIRED FURNACES

(*First Revision*)

ICS 25.180

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

October 2007

Price Group 4

Industrial Fuel Fired Furnaces Sectional Committee, MTD 26

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by Industrial Fuel Fired Furnaces Sectional Committee had been approved by the Metallurgical Engineering Division Council.

Shortages and resulting changes in the supply, sources as well as low sulphur requirements have forced blending or changing mixes of base materials of the commercially available fuel oils. As a result, the fuel oil users can no longer count on steady properties (like pour point, velocity) and are likely to encounter problems of separation or degradation in the storage tanks and should therefore design or revamp his oil handing and storage systems to suit the worst type of fuel oil he receives and also incorporate certain broad precautions suggested in this standard. Much of the advantages of efficient firing is lost if fuel oil system is not properly designed, laid out and maintained.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

CODE OF PRACTICE FOR INSTALLATION OF OIL SUPPLY UNITS FOR FUEL — FIRED FURNACES

(First Revision)

1 SCOPE

1.1 This standard covers the requirements of fuel oil supply installation for the furnaces in the following categories:

a) Transfer of oil from the transport vehicle to a storage tank, and

b) Equipment to filter strain and preheat the oil, as may be required and pump it from the storage to the burners either directly from a pipeline ring system or through a service tank and secondary oil ring.

The above two are most important but often-neglected sections of any fuel oil supply system for firing application. A portion of the fuel oil is often left in the storage tanks in the form of sludge or emulsion.

Since this standard deals particularly with the installation of oil supply units, oil burning equipment and related accessories for combustion control are excluded from its scope. This standard broadly points out what is necessary in a good fuel oil storage and handling system.

1.2 All oil storage installation shall also conform to the *Petroleum Rules* 1976, and its subsequent amendments and shall require necessary license from Chief Inspector of Explosives, India.

2 REFERENCES

The following standards contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreement based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
803 : 1976	Code of practice for design fabrication and erection of vertical mild steel cylindrical welded oil storage tanks (*first revision*)
1239 (Part 1) : 2004	Steel tubes, tubulars and other wrought steel fittings — Specification: Part 1 Steel tubes (*sixth revision*)
1239 (Part 2) : 1992	Mild steel tubes, tubulars and other wrought steel fittings: Part 2 Mild steel tubulars and other wrought steel pipe fittings (*fourth revision*)
1979 : 1985	High test line pipe (*second revision*)
2171 : 1999	Specification for portable fire extinguishers, dry powder (cartridge type) (*fourth revision*)
2878 : 2004	Fire extinguisher, carbon dioxide type (Portable and trolley mounted — Specification (*third revision*)
8849 : 1991	Glossary of terms relating to fuel fired industrial furnaces (*first revision*)
10204 : 2001	Specification for portable fire extinguisher mechanical foam type (*first revision*)

3 TERMINOLOGY

For the purpose of this standard, besides the definitions given in IS 8849, the following shall apply:

3.1 Specific Gravity — The specific gravity is defined as the ratio of the density of the oil to the density of water at a particular temperature (generally 15°C).

3.2 Density/Specific Weight — The density/specific weight is defined as the weight of a unit volume of oil, usually designated by ρ (rho), in kg/m^3.

3.3 Viscosity — Viscosity is the tendency of oil to resist flow. It is measure of resistance to flow. The viscosity is commonly measured in seconds Redwood I scale, which is the time taken for a fixed volume of oil to flow through an orifice of fixed dimension under specific conditions. There are other scales to measure viscosity like Seybolt Seconds Universal (SSU), Degrees — Engler etc. An oil having a viscosity above 1 500 seconds Redwood I requires preheating for satisfactory pumping.

3.3.1 *Absolute Viscosity (Dynamic Viscosity)* — A measure of the tendency to resist flow, without regard to the density.

3.3.2 *Kinematic Viscosity* — The relative tendency of the fuel oil to resist low, including the effect of its density.

$$\text{Kinematic viscosity} = \frac{\text{Absolute viscosity}}{\text{Density}}$$

3.3.3 *Pour Point* — Lowest temperature at which an oil will pour or flow without disturbance under the prescribed conditions of the ASTM method. For distillate oils, it is a measure of pump ability under low temperature conditions. For certain residual oils, however, it is not a reliable indication of low temperature handling characteristics.

3.3.4 For the purpose of this section the definition of 'Design Pressure' shall be considered. Design pressure is the maximum pressure that can occur at the bottom of a tank due to overfilling to the extent that oil flows from the vent shall apply. Design Pressure includes static head plus pressures developed due to friction losses in the pipelines.

4 RECEIVING, UNLOADING AND DRAINING FUEL OILS

4.1 Modes of Delivery

Oil may be delivered by road, rail, water, surface transportation or pipelines and discharged into main storage. Supervision of this operation is necessary.

4.1.1 *Road Delivery Vehicle*

Deliveries of fuel oil by road are made by vehicle tankers with capacities upto 15 kl. Fuel oil is discharged into the receiving pits by gravity or into the storage tank by pump.

4.1.2 *Rail Tank Cars*

The oil is delivered in full rail tank cars in capacities of around 20 t. Full train loads of 500 t or more may be delivered subject to conditions governing rail movement. Properly planned siding shall be installed for deliveries. Heavy grade of oil may require heating to minimum handling temperatures before discharging. For this purpose rail tank cars should be fitted with steam coils. In such cases, at the unloading installations adequate amount of steam should be available. While discharging, care should be taken to ensure that rail cars are properly vented.

4.1.3 *River and Coastal Tankers*

Where suitable berthing facilities and satisfactory arrangements can be made, delivery of oil may be either by river or coastal tankers. The size of the vessel shall depend upon local conditions and also depth of water in the approaches. These vessels are usually equipped with suitable pumps for discharging into the ground storage.

In discharging, particular attention shall be paid towards preheating the oil (if required), the sequence of operation of valves and pipe work for drainage. Connections shall be at a convenient height normally about 1 m above ground level and with easy access.

5 OIL STORAGE AND SERVICE TANKS

5.1 Oil storages tanks may be either;

a) Overground,
b) Underground, and
c) Semi-buried.

Storage tanks can be either indoor or outdoor. Indoor storage is not recommended from safety point of view.

5.1.1 *Overground Storage Tanks*

Typical steel concrete storage tanks are not commonly used and may be deleted used in outdoor above ground are shown in Fig. 1.

Smaller fuel oil tanks may be of horizontal cylindrical construction, usually sent to plant site completely fabricated. Such horizontal above ground tanks should have fire resistive concrete supports. The fill and suction lines extend to near the bottom at opposite ends of the tank. It is a better practice to bring the lines into the tank from the top rather than through the ends as it permits the use of either high or low suction and also eliminates the possibilities of leakage from the lines where these enter the tank.

5.1.2 *Underground Storage Tanks*

A typical underground fuel oil storage tank is shown in Fig. 2. Heavy underground tank may tend to sink, if placed on poor base or may tend to float, if buried in very wet ground. It should be anchored to the slab with iron rod hoops, if there is any possibility of floating. In any case the total weight of the tank, the concrete and any soil above must be greater than the buoyancy of the empty tank.

5.2 Storage Capacity

The capacity of the storage tanks for oil fired installation is important. The capacity required, depends on a number of factors including (a) firing or usage rate, (b) dependability and availability of supply, (c) method/mode of supply, and (d) possibility of supply hazards such as strikes, weather or other unforeseen delays. It is recommended that approximately 2-3 weeks supply of oil at maximum rate of consumption should be stored taking also into consideration the quantity of oil that may be delivered at a time. It may be desireable to provide more than one tank, each of sufficient capacity to accept at least one full 'rake' delivery. Different grades of oil shall be stored separately.

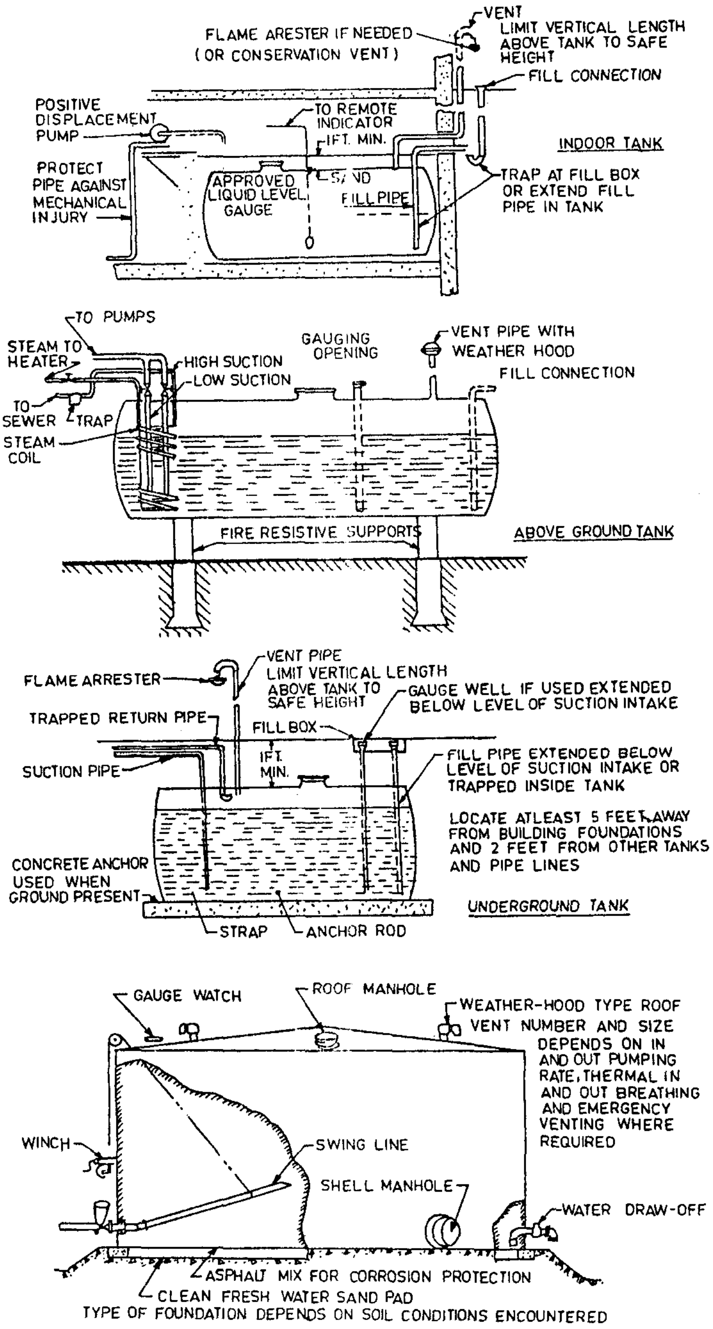

VENT
LIMIT VERTICAL LENGTH ABOVE TANK TO SAFE HEIGHT
FLAME ARESTER IF NEEDED (OR CONSERVATION VENT)
FILL CONNECTION
POSITIVE DISPLACEMENT PUMP
TO REMOTE INDICATOR
1FT. MIN.
INDOOR TANK
PROTECT PIPE AGAINST MECHANICAL INJURY
APPROVED LIQUID LEVEL GAUGE
SAND
FILL PIPE
TRAP AT FILL BOX OR EXTEND FILL PIPE IN TANK
TO PUMPS
STEAM TO HEATER
HIGH SUCTION
LOW SUCTION
GAUGING OPENING
VENT PIPE WITH WEATHER HOOD
FILL CONNECTION
TO SEWER
TRAP
STEAM COIL
FIRE RESISTIVE SUPPORTS
ABOVE GROUND TANK
VENT PIPE
LIMIT VERTICAL LENGTH ABOVE TANK TO SAFE HEIGHT
FLAME ARRESTER
GAUGE WELL IF USED EXTENDED BELOW LEVEL OF SUCTION INTAKE
TRAPPED RETURN PIPE
FILL BOX
1FT. MIN.
SUCTION PIPE
FILL PIPE EXTENDED BELOW LEVEL OF SUCTION INTAKE OR TRAPPED INSIDE TANK
LOCATE ATLEAST 5 FEET AWAY FROM BUILDING FOUNDATIONS AND 2 FEET FROM OTHER TANKS AND PIPE LINES
CONCRETE ANCHOR USED WHEN GROUND PRESENT
UNDERGROUND TANK
STRAP
ANCHOR ROD
GAUGE WATCH
ROOF MANHOLE
WEATHER-HOOD TYPE ROOF VENT NUMBER AND SIZE DEPENDS ON IN AND OUT PUMPING RATE, THERMAL IN AND OUT BREATHING AND EMERGENCY VENTING WHERE REQUIRED
WINCH
SWING LINE
SHELL MANHOLE
WATER DRAW-OFF
ASPHALT MIX FOR CORROSION PROTECTION
CLEAN FRESH WATER SAND PAD
TYPE OF FOUNDATION DEPENDS ON SOIL CONDITIONS ENCOUNTERED

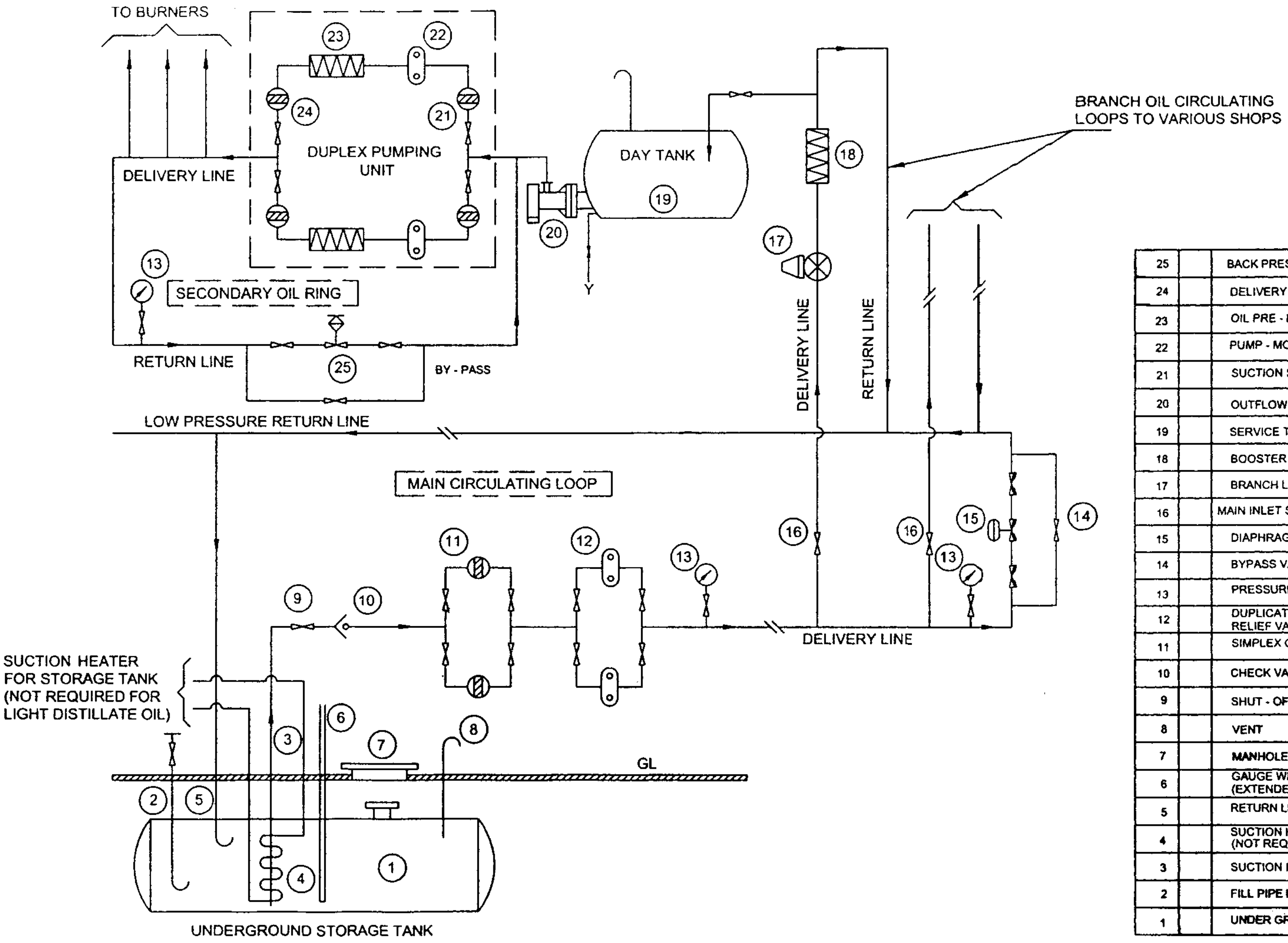
FIG. 1 STORAGE TANKS

5.3 Auxilary/Service Tank

A relatively small capacity service tank (Day tank) can be installed in the shop near the furnace installation meant to serve either one furnace (if the unit is big having a large number of burners) or a group of small furnaces. The advantage of having such a service tank or day tank in between the storage tank and the burners in the furnace is to ensure more uniform and balanced flow of oil to individual numbers in the furnace through the pumping unit (in case of light diesel, or a composite heating-*cum*-pimping unit (in case of heavy grade fuel oils) and a secondary oil ring regardless of any possible fluctuation in the low characteristics of oil through the main oil circulating loop.

5.4 Tank Construction

Fuel oil storage and service tanks may be steel welded construction constructed of steel, careful review of the adherence to standard/codes recommended by competent statutory authorities will ensure an approved safe installation. The construction of tanks may be horizontal (either cylindrical or rectangular) or vertical cylindrical.



25		BACK PRESSURE REGULATING VALVE WITH BY PASS
24		DELIVERY SIDE FILTER
23		OIL PRE - HEATER
22		PUMP - MOTER UNIT
21		SUCTION SIDE FILTER
20		OUTFLOW HEATER
19		SERVICE TANK (DAY TANK)
18		BOOSTER HEATER (IF REQUIRED)
17		BRANCH LOOP PRESS REGULATOR
16		MAIN INLET SHUT - OFF VALVE FOR BRANCH LOOP
15		DIAPHRAGM RELIEF VALVE
14		BYPASS VALVE
13		PRESSURE GAUGE WITH COCK
12		DUPLICATE PUMP WITH INTEGRAL PRESSURE RELIEF VALVE
11		SIMPLEX OIL FILTER
10		CHECK VALVE
9		SHUT - OFF VALVE
8		VENT
7		MANHOLE
6		GAUGE WELL (EXTENDED BELOW THE LEVEL OF SUCTION INTAKE)
5		RETURN LINE
4		SUCTION HEATER (NOT REQUIRED FOR LIGHT DISTILLATE OILS)
3		SUCTION PIPE LINE
2		FILL PIPE LINE
1		UNDER GROUND OIL STORAGE TAND

FIG. 2 OIL STORAGE/SERVICE TANKS AND VARIOUS CIRCULATING LOOPS

5.5 The construction cylindrical of welded mild steel tank shall conform to IS 803.

5.6 Each storage tank shall be provided with;

a) Level indicator,
b) Device for taking sample of oil/gauge well,
c) Manhole,
d) Vent pipes,
e) Filling pipes,
f) Draw off connection,
g) Drain valve (for over ground storage tanks),
h) Manhole latch,
j) Internal heating arrangement (wherever necessary),
k) Temperature measuring instrument as may be desired, and
m) Overflow connection.

5.6.1 Each storage tank may also be provided with foam drainage chamber, where considered necessary.

5.7 Overflow and leakage from the tank may contribute to a fire hazard, cause damage to properly or contaminate drains or sewer, a catch to hold full tank contents should be provided around the tanks.

6 GENERAL LAYOUT OF OIL SUPPLY INSTALLATION

6.1 Before any decision is made regarding the design and layout of oil storage tanks, local codes and safety requirements should be checked besides checking the soil and drainage conditions, proximity to water, rail and/or road transportation facilities, etc, to make sure that the final installation is safe and complies with all norms.

For the safety aspects the following specific requirements shall be considered for the entire installation.

6.1.1 Gaps and distances between the structures will depend upon the class of fuel and the capacity of the storage tank. These shall be governed by *Petroleum Rules* and *Act*, 1976.

6.1.2 Storage tanks located above ground in groups shall be protected with a continuous embankment (dyke) or wall of not less than 0.8 m and not more than 2 m in height.

7 PRE-HEATING FOR STORAGE AND PUMPING

7.1 To facilitate flow and to ensure proper atomization, fuel oil require heating according to their grade at various stages. However, all petroleum products tend to deteriorate to some extent as temperature increases and particularly if they are exposed to repeated heating and cooling. While many fuel oil grades are specifically treated or inhibited to resist this deterioration, residual fuel grades are not for economic reasons.

Whether in the transportation tankers, storage tank, service tank or in piping, the fuel oils should not be over heated above the temperature necessary to obtain the required viscosity for pumping, filtering or atomization. The fuel oils should also be held at this elevated temperature for the shortest possible time. A good yardstick is to:

a) heat only when necessary,
b) only as much as necessary, and
c) and for the minimum length of time.

It is seldom necessary to heat a fuel oil above 30°C-40°C for easy pumping and above 80°C-100°C for atomizing.

Fuel oil preheater should provide maximum practical heat transfer are to keep the skin temperature as low as possible to prevent caking of the fuel oil and deposit build-up on the heater.

Thermostatically controlled heaters are usually located in the suction bell. The temperature of preheat will also depend on the type of fuel oil.

Heating coils or elements should be evenly spaced. The oil draw-off point should be above any coil, element or thermostat. An outflow heater may also be installed as per requirement, particularly in the service/day tank. Heating can be by steam, electricity or liquid phase system. Where the heating is by electricity, the system should be of flame proof design.

8 HANDLING FROM STORAGE TO BURNERS

8.1 The components of the fuel oil transfer system for example pumps, filters, pipelines, heaters, etc, shall be adequately sized, laid out and installed, if the system is to give satisfactory and trouble free service.

Fuel oil handling system transfers oil from storage to the burners at specified conditions of viscosity, temperature, pressure and rate of flow. Date on handling temperatures for different grades of oil are available in the form of various charts/documents usually provided by fuel oil producers/dealers.

The diagram shown in Fig. 2 shows oil storage/service tanks and various circulating loops upto the burner which may be required for a fairly large distribution network. If the fuel oil consuming points are not too many and not far away from each other or from the storage tank, the branch circulating loops may not be required.

9 FILTRATION

9.1 Fuel oil shall be filtered to prevent foreign matter from damaging small pipes, orifices, pumps and/or other equipment. Filtration should normally be in two stages — in the first stage straining between storage tank and pumping station and in the second stage finer filtration for valves, atomizers and similar equipment between pumps and burners. The effective filtering area of any filter should be sufficient to avoid frequent cleaning. First stage filter shall be placed in the draw-off line as near as possible. Pressure gauges may be installed on either side of filters. Phosphorous bronze or stainless steel wire mesh shall be preferably used as filtering material. Fineness of filters shall be selected in line with system requirement.

10 OIL HANDLING SYSTEM

10.1 Though there are varieties of systems to convey oil from storage tanks to the firing equipment, the following general principles apply to all systems.

10.1.1 Oil shall be efficiently filtered to avoid any chocking due to deposits of sediments.

10.1.2 Corrosion resistant materials shall be used in the system.

10.1.3 Venting of the system shall be provided at the highest points.

10.1.4 Provisions shall be kept for draining the oil from the piping system. It is preferable to slope the pipelines towards the pump.

10.1.5 Essential items like stand-by pumps shall be provided to ensure uninterrupted operation. Solation and by-pass facilities of vital units of oil systems shall be provided to ensure servicing facilities.

10.1.6 Compact/composite pumping, heating and filtering units shall be envisaged, wherever possible.

10.2 Types of System

Two main types of oil handling systems are the gravity and the ring main systems.

10.2.1 Gravity system may be sub-grouped as gravity, pump assisted gravity and sub-gravity systems based on the mode of flow of oil from storage to burner.

10.2.2 In a ring main system, oil is drawn from storage and circulated to each consuming point in turn, the balance of the oil being returned either to the suction side of the circulating pump or to the storage or both. In the ring main systems oil is circulated at a quantity of 1.5 to 3 times the maximum off take from the circuit usually, a pressure regulating valve is provided near the last off-take point to maintain fluctuations in the pressure conditions to the minimum.

Ring main systems may be classified further based on the temperature of oil circulating in the system.

10.2.2.1 Hot oil ring main system circulates oil at suitable temperature and shall be preferred to other systems as it offers economy of installation and running costs. Insulation of oil ring mains including branch pipes and flexible hoses up to the burners minimizes the heat loss in the system.

10.2.2.2 Warm oil ring main systems include provision of heaters in the circuit to maintain oil temperature between minimum handling and atomising temperature requirements. The circulation temperature shall be chosen to match the pumpability limits and minimum pressure drop in the system.

10.2.2.3 Cold oil ring main system is mainly used where different atomising temperatures are required at various consuming points or where a branch line becomes uneconomically long. Additional heating facilities shall have to be provided wherever required.

10.3 Suction Pipelines

10.3.1 As a rule, suction pipelines shall be as short as possible. Minimum number of fittings shall be installed in the suction lines and these lines shall be lagged wherver necessary. Sizing of suction pipelines shall be based on suction lift required at the pump inlet together with the resistance of oil filters, heaters, valves, pipelines and other fittings.

10.3.2 The relative position of the oil storage tank and the circulating pump should be properly selected from layout points of view.

10.4 Pipelines

10.4.1 All pipes and pipe fittings for fuel oil handling system shall comply with the requirements specified in IS 1239 (Part 1), IS 1239 (Part 2) and IS 1979 as applicable. Generally for oil pipelines upto 10 atmospheric pressure, mild steel pipes and pipe fittings may be used. Above 10 atmospheric pressure seamless pipes shall be preferred. Lead and zinc, galvanized metal and natural rubber shall not be used for pipe materials coming into contact with oil. An approved protective casing shall be constructed round the pipe where it crosses railway track or road.

10.4.2 Pipelines joints may be welded, screwed, socketed or flanged. Cross over of oil pipelines over the furnace or heating equipment should be avoided for safety reasons. Where unavoidble, welded pipelines must be used and there should be no piping joing over the furnace or heating equipment.

10.4.3 Installation of buried pipelines is generally not recommended. Where installation of buried pipelines is unavoidable they should be laid in concrete ducts which are well drained and readily accessible.

10.5 Line Heaters

To reduce the viscosity of oil to facilitate regulation and control and to reduce friction losses in pipe it may be necessary to heat the oil to the burner. Line heaters are provided in such cases between pumps and burners. These heaters may operate on electricity or steam. Combined steam and electric heaters are also available. Where line heaters heat oil up to atomizing temperature, it is essential to control the heat input so that oil viscosity is maintained within close limits.

10.5.1 Where heavy grade fuel oil, particularly those containing wax should be used, it is recommended that a suitable flushing system of the oil, distribution piping network be installed.

10.6 Heat Requirement for Pipelines

10.6.1 A handling system should maintain the specified oil temperatures under the most adverse conditions, such as when oil flow rate it at a minimum or zero. Under such conditions tracing of oil prevents the temperature in the system falling below the minimum handling temperature.

Tracing of pipelines may be done by;

a) Steam pipe placed by the side of oil pipeline with common insulation,
b) Hot water pipe clipped externally to the oil pipeline, and
c) Electric heating tapes or mantles applied externally to all pipelines and fittings.

10.7 Instrumentation and Control

10.7.1 The following instrumentation and control equipment shall be provided in fuel oil handling system:

a) Measurement of quality of fuel oil received from road/rail cars,
b) Measurement of quality (volume/mass) of fuel oil received from road/rail cars,
c) Measurement of temperature in the storage tank when provision of heating is there,
d) Measurement of liquid fuel level in the storage tank,
e) Measurement of pressure, quantity and temperature of fuel oil supplied to consumers, and
f) Measurement of quantity of steam consumed.

10.7.2 Safety interlocks/alarm annunciation of the following shall be envisaged:

a) Maximum and minimum fuel oil level in the storage tanks suitably interlocked with the delivery pump or the storage tank filling value/unloading pump as applicable,
b) Maximum and minimum temperature of fuel oil in the storage tank,
c) Maximum and minimum temperature of fuel oil in the system after heating, and
d) Minimum pressure of fuel oil line in the system after pumping.

10.7.3 The type of sensing devices shall be selected based on the specific application.

10.8 Pumping Stations

The pump-house building shall not be built with incorporating any inflammable materials.

10.8.1 Floor levels of the pump-house shall be selected depending upon the depth of embeddding of reservoirs and contour of the area. It is recommended to have the floor of the pump-house lower than that of the storages so that pumps work under positive suction.

10.8.2 The pump-house shall have filtration and pumping units.

10.8.3 In the pump-house auxiliary facilities, such as lighting and ventilation shall be provided.

10.8.4 All preventive and precautionary fire extinguishing facilities shall be installed.

10.8.5 Floor and stairs of pump-house shall be made of corrugated and non-slippery materials.

10.8.6 Floor and pump-house should have slope towards sump. For pumping of the oil from the manual pump may be provided.

10.8.7 All electric fittings of the pump-house should be of flame-proof design depending on class of fuel oil and shall conform to the relevant requirements specified in *Petroleum Rules*,1976.

10.9 Safety Precautions

10.9.1 All necessary precautions regarding safety shall be envisaged in oil unloading, storing and handling systems. Particular attention should be paid to fire prevention and fire protection facilities. The following types of fire fighting equipment are recommended for installation:

a) Foam type fire extinguisher (*see* IS 10204),
b) Dry chemical powder type fire extinguisher (*see* IS 2171),
c) Carbon dioxide type fire extinguisher (*see* IS 2878), and
d) Sand bucket.

Automatic sprinkler system and/or fire detection and alarm system may be provided, as required.

10.9.2 *Gas Cutting and/or Welding*

The following precautions should be exercised while carrying out any gas cutting/welding job on the oil pipelines:

a) Line should be emptied and preferably steam-purged, and
b) Connecting valve to the main storage tanks should be kept closed. In case of highly inflammable oil handling systems, the pipeline shall be physically disconnected from the storage tank.

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Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards : Monthly Additions'.

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